Preliminary Draft

An Investigation of the Socioeconomic Impacts of Tri-State Bypass, 1970-2000

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Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Mobile, Alabama, February 1-5, 2003

Abstract

Geographical information systems and econometric tools were used to determine the socioeconomic impacts of bypasses in Atlanta-Birmingham Metropolitan area. Mean household income and per capita income of county is separately used as a proxy for anticipated bypass impact as a function, of socioeconomic variables: farm income, farm employment, non-farm employment, age groups, and population density. The cross-sectional and the time series data were pooled together and estimated as panel data. Results indicate that most of these variables have positive impacts on growth.

Keywords: Tri-State by-pass, socio-economic, panel model, geographical information systems.

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Introduction

In the late 1960's to late 1970's, most road transportation projects involved construction of major highways. However, from 1980's onwards, majority of road transportation projects emphasized on bypass highways also referred to as simply, "bypass", and expansion of existing roads. These projects, especially bypass can have greater impacts on rural communities positively or negatively. State transportation agencies plan and build most bypasses, albeit sometimes in response to local initiative. They do so for various reasons, e.g., to reduce traffic congestion and accident hazard along the old route, to reduce travel of time through traffic, and to improve environmental conditions within the bypassed area.

Many of the objections to bypass are raised by local business, and not without some cause. Case studies from small towns with population less than 1,000 people are evidences to this problem. However, research studies (Arkansas State Highway and Transportation Agency, 1995; Babcock, 1997; Cambridge Systems Inc., 1998a; Smith and Associates, 1998) have often acknowledged that many complex factors influence local economic activity, and is difficult to draw robust statistical conclusion. Numerous studies have examined the impact of transportation on land use for example, by studying the economic impacts of transportation investments.

Economic models have been used to estimate a wide range of impacts. In some cases, researchers have simply calculated the direct user cost savings associated with the investment and have input these savings into the model. Methods used to study the impacts of bypasses range from judgments gathered in unstructured interviews and mail-surveys of local opinion to sophisticated data analyses of data on population, retail sales, land values, and other factors anticipated to respond to changes in highway system characteristics. Diamandis et al., 1997 estimate the impacts of Rion-Antirion suspension bridge in Greece after constructed. The authors used ordinary least squares regression and maximum likelihood models to determine the impacts the project had on the southern and western parts of Greece using workers' average wage rate as a proxy for development in terms of reduced driving time.

Babcock, Emerson, and Prater, 1997 addressed similar problem of estimating a statistical demand function for the recreational activity of pleasure driving (sightseeing) by car on a scenic highway in the Rocky Mountains. The authors show that single-day trips with one-way travel times of less than two hours have increased because households consider travel time devoted to pleasure driving as a benefit rather than cost. In their approach, net willingness to pay for travel time is a function of distance traveled, type of trip, opportunity cost of time, income, age, price of substitutes, and quality of scenery along the route.

To estimate tourism impacts and business expansion derived from transportation system investment, Lochmueller and Associates, 1997 used input-output models. The effects are measured in terms of personal income, output, value added, gross regional product, and employment. Many others have examined the impact of investment on land use and land values (Cervero, 1994; Gatzlaff and Smith, 1993; Lewis-Workman and Brod, 1997).

The results of such studies have raised questions regarding the strength of transportation-economic (more socio-economic) activity relationship. Using household income as a proxy for development, this paper examines the socioeconomic impacts of highway bypasses in the Atlanta-Birmingham metropolitan area from 1970 to 2000. This is a tri-state 55-county region bounded in the east by interstate 85, and west by interstate 65, and the south by interstate 20, and the consist of network of bypasses.

Theoretical Model

Analytical approaches to estimating the effects of transportation investment on economic development started out using cost-benefit analysis. More recently, the profession has turned to production and cost function as a way to include wider range of benefits. However, transportation facilities are located in specific, they provide services to business (and households) within a specific geographical area, and their use is directly related to moving goods and people between two points (Eberts, 2001).

In this study, the analysis is focused on the mean output generated from goods and services by the average household in county i in time t. Thus, we assume business income to be part of household income. Geographical Information Systems (GIS) is used to map out all the counties in the regional and their individual boundaries. Our most basic assumption is that there exists a relationship between the socioeconomic variables and outputs that can be written in a convenient mathematical form.

$$\mathbf{Y_i\,(y_i, z_i) = 0.}$$

Where, $\mathbf{Y_i}$ is the mean of aggregate output produced in county i any particular time and $\mathbf{z_i}$ and are $\mathbf{y_i}$ are vector of nonnegative inputs and outputs in county i, respectively.

Empirical Procedures

Historical annual county level data on income, employment, age, and population such as that available from the National Agricultural Statistical Services (NASS); U.S. Census Bureau; are employed here to examine the effects of bypass on household income and per capita income. This section includes descriptions of (1) statistical time series and time series cross-section models, (2) procedures to construct the variables employed in the analysis.

Estimation with panel data allows us to control for individual heterogeneity, alleviate aggregation bias, and improve efficiency by using data with more variability and less collinearity. With number of cross sections more than time series, the use of two-way random effects is suggested (Greene and Kennedy). Hence, we use the random effects panel model that accounts for the spatial and temporal error correlation.

Statistical Time Series and Time Series Cross Section Models

Functional form representing the changes in socio-economic variables due to Tri-State Bypass induced changes on household income (*hincome*) and per capita income (*ipercap*) is represented as:

$$(2) \quad \begin{aligned} \text{hincome} &= f(x, z) \\ \text{ipercap} &= f(x, z) \end{aligned}$$

where x represents economic variables (farm employment, nonfarm employment, farm income and population density) and z represents socio-economic (age groups) variables. Equation (2) estimating county household income and per capita income (y_{it}) can be modeled as time series regression:

(3) $$y_{it} = \alpha_i + \sum_{k=1}^{K} x_{itk}\,\beta_{itk} + \varepsilon_{it} \qquad i = 1,....,N; \quad t = 1,....,T; \quad k = 1,....,K$$

or TSCS regression

(4) $$y_{it} = \alpha + \sum_{k=1}^{K} x_{itk}\beta_k + \varepsilon_{it} \qquad i = 1,....,N; \quad t = 1,....,T; \quad k = 1,....,K$$
$$\varepsilon_{it} = u_i + \upsilon_t + w_{it}$$

where N, T and K are the number of counties, length of the time series for each county, and number of independent variables respectively. Equation 3 (equation 4) represents the individual county TS model (tri-state area counties TSCS model). The independent variables (x_{itk}) include the farm employment $(x_{it,1})$, nonfarm employment $(x_{it,2})$, farm income $(x_{it,3})$, percentage of people within age group 20 to 59 year $(x_{it,4})$, percent of people within age above 60 year $(x_{it,5})$, and population density $(x_{it,6})$. The error term (ε_{it}) in the time series (equation 3) model follows a standard normal distribution with mean zero and variance (σ_{ε}^2) compared to decomposition of the error term into cross section error component (σ_u^2), time series component (σ_{υ}^2) and combined error component (σ_w^2) in the TSCS (equation 4) model.

Temporal heteroskedasticity (consistent and increased variability of dependent variable over time) of county level income (household and per capita) in the time series model are examined employing the Harvey and Glejser tests as described in

Greene. The presence of temporal heteroskedasticity is accordingly corrected in the time series model. Within the time series cross section model, first we examine if random effects or the fixed effects model better fits the data employing the Hausman test as described in Greene. According to Greene, high (low) values of Hausman test favor fixed effect model (random effects model) in time series cross-section model. Second employing the LM test as described in Greene, we examine for spatial heteroskedasticity across the counties in the time series cross section model given temporal heteroskedasticity is examined in the time series model. Examination and correction for the temporal and spatial heteroskedasticity, and the choice of time series cross-section model allows examining the effects of exogenous variables on income. Identical variables are maintained across the time series and time series cross section models.

Data and Methods

For this bypass impact study, data are gathered primarily from the 1970-2000 U.S. Census Bureau and the National Agricultural Statistical Services (NASS). Time series data on socioeconomic variables such as household income, farm income, (all in 1992 real levels) farm employment, wage employment, non-farm employment, age groups, and population density were purchased from U.S. censuses.

Results

The coefficient estimates of economic and socio-economic variables for the two-way random effects panel models in equation (4) from Tri-state area demonstrate the importance of bypass on the household income and per capita income. Two analyses are presented these include 1) a county-level analysis using data from 1970-2000 with household income being the dependent variable, and 2) a county-level analysis using data from 1970-2000 with per capita income being the dependent variable. The results from the analyses are presented in Table 1.

The regression results presented in Table 1 indicate that farm employment, percentage of population between 20 and 59 years, percent of population over 60 years, and population density positively impact the level of household income and per capita income in the region. The positive impact of age between 20 and 59 and population density comes as no surprise. For population density, maps prepared from GIS, which show the changes in household income over the 31-year period indicate larger changes in household income in the densely populated urban areas than the rural counterparts. In the case of the percent of population between 20 and 59, these are the working age and therefore contribute to growth.

In the case of the ages 60 years and over, these are the retired people with higher incomes that have been migrating south, especially into suburbs in Atlanta. These people, even though are not working, most have higher retirement incomes. The only surprising result is the impact farm employment, number of farmlands has declined in most parts of the study area, especially, northwest Georgia and northeast Alabama, consequently, we would expect an insignificant impact from farm employment. The possible reason for the positive impact may be that even though the number farms has declined, there is an increased in farm sizes (mainly due to corporate farms) which has brought in some efficient farm employees. The overall R-squares in both models are low but the coefficients of almost all the variables are significant and have the right signs.

Conclusion

Most of the economic and socioeconomic variables used to determine the impact of bypass have significant coefficients and expected signs. Even though the overall R-squares in both models are low, most of these variables are that associated with growth. As a further research, we will try incorporate some land use data such as residential and commercial development and see whether this will raise the explanatory power of the models.

Table 1. Time Series Cross Section results of the Effects of Tri-State By-pass

Variables	Parameter Coefficients	T-value
Hincome is the dependent variable		
Intercept	-8.671	-1.89
efarm	0.898	3.74
enonfarm	0.001	0.29
infarm	0.015	0.61
age2059	0.764	10.68
age60PL	0.507	6.78
pdens	0.010	11.88
R-square	***0.1387***	
Ipercap is the dependent variable		
Intercept	-7.043	-3.71
efarm	0.376	4.06
enonfarm	0.000	-0.26
infarm	0.014	1.47
age2059	0.321	10.80
age60PL	0.229	7.62
pdens	0.005	16.77
R-square	***0.1983***	

References

Arkansas State Highway and Transportation Agency. 1995. "Corridor 18 Feasibility Study." Little Rock, AR: Arkansas Highway and Transportation Agency.

Babcock, Michael W., M. Jarvin Emerson, and Marvin Prater. 1997. "A Model-Procedure for Estimating Economic Impacts of Alternative Types of Highway Improvement." *Transportation Journal*, Vol. 36, No. 4 (Summer), pp. 30-44.

Cambridge Systems Inc. 1998a. "Economic Impacts of Wisconsin Highway 29/45/10 Alternative. Washington D.C: Cambridge Systems Inc. for the Wisconsin Department of Transportation.

Cervero, Robert. 1994. "rail Transit and Joint Development: "Land Market Impacts in Washington, D.C. and Atlanta. *Journal of American Planning Association*, Vol.60 N0. 1 (Winter), pp. 83-94.

Gatzlaff, Dean H., and Marc. T. Smith. 1993. "The Impact of Miami Metrorail on Value of Residences Near Station Locations." *Land Economics*, Vol. 69, No. 1 (February), pp. 54-67.

Diamandis, P.F., G.P. Kouretas, and P. Tzanetos. 1997. "Modeling the Choice of Mode and Estimation of the Value Travel Time Savings for the Case of the Rion-Antirion Suspension Bridge in Greece. *Annals of Regional Science*, Vol.31, No 4. pp 473-489.

Eberts, Randall, 2001. "Understanding the Impact of Transportation on Economic Development." W.E. Upjohn Institute *Transportation Research Board*.

Hausman, J.A. (1978) Specification Tests in Econometrics. Econometrica, 46, 1251-71.

Kmenta, Jan. 1986. "Elements of Econometric Second Edition". Macmillian publishing Company, New York, New York.

Lewis-Workman, Steven, and Daniel Brod. 1997. "Measuring the benefits of Rail Transit Accessibility." *Transportation Research Record 1576*, pp. 69-86.